

REPORT OF THE  
LONDON AIRPORT  
DEVELOPMENT COMMITTEE

To the  
Minister of Transport and Civil Aviation





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# Report of the London Airport Development Committee

## COMPOSITION OF THE COMMITTEE

### 1. Sir Eric Millbourn, C.M.G., *Chairman*

Air-Vice Marshal Sir Victor Tait, K.B.E., C.B.*	} British Overseas Airways Corporation	
Mr. J. R. Stainton		
Mr. E. P. Whitfield	} British European Airways	
Air Marshal Sir John D'Albiac, K.C.V.O., K.B.E., C.B., D.S.O.		
Mr. J. W. L. Ivimey	} Ministry of Transport and Civil Aviation	
Air Commodore W. E. G. Mann, C.B., C.B.E., D.F.C.		
Mr. J. W. Moncur, C.B.E., M.I.C.E.		
Mr. G. I. Morris, C.B.		
Air Vice-Marshal S. P. Simpson, C.B., C.B.E., M.C.*		
Mr. G. W. Stallibrass, O.B.E.		
<i>Joint Secretaries:</i>		
Mr. I. V. Pugh*		
Mr. C. B. Collins, O.B.E.*		
Mr. M. H. Vivian		
Mr. K. A. Heathcote		

Other officers of the Ministry of Transport and Civil Aviation and of the airline corporations attended the Committee as advisers or served on sub-committees.

## INTRODUCTION

### TERMS OF REFERENCE

2. We were appointed by your predecessor on 27th October, 1955, "to review the development of London Airport since the Report of the Layout Panel in 1946 and to make recommendations for the next phase and in particular for the most economical means of meeting requirements for:

- future passenger handling;
- accommodation for freight handling;
- hangars in the maintenance areas;
- apron accommodation;
- car parks;
- the internal road system."

### CONSULTATIONS

3. We met eleven times and set up a number of sub-committees to consider detailed questions. The Chairman, accompanied by representatives of the Ministry and airline corporations, visited New York in July, 1956, in order to gain first-hand knowledge from the Port of New York Authority of the trends in airport design at New York's airports, and to exchange views on common problems. We wish to record our gratitude for the facilities which the Authority so generously accorded to our representatives and for the insight they gave us into their plans.

We were informed of plans for development at major European airports and in particular we must acknowledge the valuable information given to us by the Director of the Civil Aviation Office, Directorate of Public Works, Zurich.

We also gratefully acknowledge the co-operation we received from Shell-Mex and British Petroleum, Ltd., the Esso Petroleum Co., Ltd., the London representatives of the foreign airlines using London Airport and the British Independent Air Transport Association whom we informed of our plans when these were beginning to take shape.

\* Air-Vice Marshal Simpson and Sir Victor Tait resigned from the Committee on relinquishing their appointments with the Ministry and British Overseas Airways Corporation respectively. Sir Victor Tait was succeeded by Mr. J. R. Stainton. Mr. Pugh resigned as Secretary on taking up a new appointment with the Ministry and was succeeded by Mr. Collins, whose services were lost to the Committee by illness. Mr. Collins was succeeded by Mr. Vivian and Mr. Heathcote as Joint Secretaries.



In the later stages of our work we consulted the architect for the central terminal area of London Airport, Mr. Frederick Gibberd, C.B.E., F.R.I.B.A., M.T.P.I., whose advice and assistance have been of the greatest value.

#### REVIEW OF THE DEVELOPMENT OF LONDON AIRPORT

4. In 1945 an Advisory Layout Panel was appointed by the then Minister of Civil Aviation to make recommendations for the best layout of the international airport at Heathrow, making full use of the three runways under construction for the Royal Air Force. The proposals of this Panel, having been accepted in 1946 by the Government of the time, formed the framework of the subsequent development of the airport. Three successive stages of development\* were planned, and at the time when we took up our duties two of these stages, with some modifications, had been completed.

5. Thus, in January, 1946, when the airport first came into use for civil aviation it consisted of one runway, with two more runways under construction, in accordance with the plans laid down by the Royal Air Force; improvised huts and tents for the service of passengers; and maintenance facilities and air traffic control which by today's standards would be regarded as rudimentary. The airport is now the largest and busiest in Europe with six runways, modern passenger, administrative and air traffic control buildings (first brought into service by the Ministry of Transport and Civil Aviation in 1955) and maintenance facilities in which the airlines have invested many millions of pounds.

6. The layout adopted by the original planners (see Appendix I) had to suit the operating requirements of the aircraft then in use and in prospect. Runways had to be built in enough directions to enable such aircraft to use the airport in most conditions of wind, based on a maximum cross-wind component of 12 miles per hour. The choice lay between two possible runway patterns—the "tangential" runway pattern and the "parallel" runway pattern—and in the event, the Advisory Layout Panel adopted the latter.† Given either of these multi-directional runway systems, the siting of the terminal area in the centre was seen to have advantages for aircraft operation on the ground outweighing both the risk that the available terminal area might be too restricted and the disadvantage that it could only be approached by means of a tunnel. Within these limits the Panel produced a flexible plan which allowed for gradual development of terminal buildings as required by growing traffic.

7. In the ten years since the Panel reported civil aviation has undergone profound changes. The traffic has grown from 183,000 passengers in 1946 at both London Airport and Northolt to just over 3,000,000 at London Airport alone in 1956, and the air transport movements have increased eightfold. The size and speed of aircraft and the complexity of operations have also greatly increased.‡

8. Inevitably in a period of such swift and radical change some of the conditions commonly accepted ten years ago by airport planners have been altered. Indeed, at all major airports throughout the world planners of today are thinking about many aspects of the problem in very different terms from their post-war predecessors. Before we leave the past it is proper to record that in fact what has been carried out at London Airport on the basis of the plans laid in 1946 has not only given us an airport which is generally recognised as one of the finest in the world but has also provided a structure which we believe can be adapted to serve future traffic of four times its present volume.

#### APPROACH TO THE NEXT PHASE OF DEVELOPMENT

9. In approaching the next phase of development, we are conscious that we have the advantage both of the foundations laid by our predecessors and of ten years' experience of the operation

\* Stage I was to consist of the three R.A.F. runways under construction, together with the taxiway parallel to No. 1 runway and temporary buildings on the Bath Road. 70 acres for aircraft maintenance were available. Stage II provided for a dual parallel runway system south of the Bath Road, replacement of the NW/SW R.A.F. runway and provision of a large part of the central apron and those parts of the present terminal buildings required. In addition, it provided for the underground access to the terminal area, and all the areas allocated for aircraft maintenance, parking and other purposes. Stage III consisted in extending No. 1 runway westwards, constructing Nos. 3, 9 and 10 runways north of the Bath Road with their connecting taxiways, and increasing as necessary the facilities in the terminal area. (Note: It was decided in 1952 not to proceed with the runway layout north of the Bath Road since it was considered that the comparatively small additional capacity which would result would not justify the expenditure and the disturbance to the local community.)

† The tangential pattern had been adopted for New York International but has been gradually modified to incorporate parallel runways.

‡ On the short-haul routes the 21-seater 158 m.p.h. Douglas DC-3 which then held the field has been largely superseded by the 47-52-seater 308 m.p.h. Vickers Viscount 700 series. On the long-haul routes compare, for example, the 44-seater 262 m.p.h. DC-4 with the 91-seater 356 m.p.h. Britannia 103.

of an international airport during a period of rapid change. At the same time we realise that whatever we recommend may so fix the layout of London Airport that major changes thereafter will be costly, if not impracticable, and that the next phase of development may therefore be decisive. We have accordingly resisted the temptation to take short cuts or to deal simply with the residual and admittedly pressing tasks left over from Stage II of the Advisory Layout Panel's recommendations. Instead we decided to approach the problem from first principles, even though this might prolong our work, in order to see whether any variations in the master plan were required at this stage. Thus we asked for a fresh assessment of the future traffic and of the various factors affecting the capacity of the airport in all its functions. We then set out to achieve the best balance between requirements and available space, bearing in mind throughout the need to make full use of the facilities already provided during the first phases of development.

10. It seems impossible to forecast with any degree of realism much beyond 1970: our calculations must be based largely on what we can reasonably expect to happen during the next fifteen years. While it is easy to imagine developments in the decade after next which may again transform airport requirements, the existing generations of aircraft and those known to be already on the drawing boards must first be catered for. The best we can hope to achieve is a plan for the third stage which, like its predecessors, will be flexible enough to allow for the full utilisation of the airport in foreseeable conditions.

## ESTIMATES OF REQUIREMENTS AND CAPACITY

11. We have had before us a mass of statistical material relating on the one hand to the past and probable future traffic in the London area and, on the other, to the capacity of the airport.

### GROWTH OF TRAFFIC

12. The following table shows the growth of traffic from 1946 to 1956:

<i>Traffic at London and Northolt Airports</i>			
	<i>Terminal Passengers</i>	<i>Air transport aircraft</i>	<i>Freight</i>
	<i>(thousands)</i>	<i>movements</i>	<i>(short tons)</i>
1946 ... ..	183	13,428	2,700
1950 ... ..	1,227	73,147	19,154
1956* ... ..	3,026	109,046	44,508

Since 1950 passenger traffic has increased on the average by 16 per cent and air transport movements by 7 per cent a year.† From detailed forecasts put before us we think it reasonable to expect that passenger traffic will continue to increase by very nearly this rate up to 1960 and thereafter at a rate of 12 per cent a year, falling to 9 per cent a year after 1965. This assumes, among other things, a fairly steady rise in the standard of living and a continued fall in air fares relative to those of surface transport.

13. It will be seen from the estimates at Appendix 2 that, after allowing for the transfer of Channel Islands services to Gatwick from 1958, the passenger traffic offering at London Airport, given sufficient capacity, is expected to rise to something of the order of 9 million passengers in 1965 and 13½ million by 1970. To provide for these numbers London Airport would have to be capable of handling 211,000 air transport movements a year by 1965 and from 225,000 to 280,000‡, depending on the aircraft seating capacities, by 1970; or, given the present pattern of traffic peaks, as much as 77 movements at the peak hour in 1965 and from 85 to 106 at the peak hour in 1970.

### CAPACITY OF THE AIRPORT

14. A critical factor in determining the ultimate capacity of an airport is the rate at which aircraft can be safely permitted to take off from and land on the available runways. When movements reach a high intensity the problem centres on the performance of the aircraft using

\* Northolt civil traffic transferred to London Airport in 1954.

† Aircraft movements have not increased in the same proportion as passenger movements because of the use of progressively larger aircraft with a greater seating capacity assisted by the growth of Tourist class services with less spacious seating standards. These trends are expected to continue.

‡ The range of 225,000 to 280,000 movements by 1970 is given because of the inevitable uncertainty about aircraft size as far ahead as 1970. The higher figure is based on an average aircraft size of 80 seats. A number of major airlines have already ordered long-range aircraft which in certain versions may be capable of carrying more than 150 passengers; on short-haul routes it seems likely that aircraft capable of carrying more than 100 passengers will be in general service by the early 1960s. We must reckon with the possibility that the average size of aircraft may rise to 100 seats by approximately 1970.

the airport and the ability of air traffic control to provide the most rapid flow of aircraft during landing, ground movement and take-off, to maintain the degree of separation required for safety and to keep the airways free of congestion in the crowded airspace around the airport. We have accordingly given much thought to the question of what is the highest movement rate that air traffic control could manage to handle at London Airport within the next fifteen years.

15. In 1956 our controllers handled a peak of 41 movements in the hour. The technique of air traffic control is constantly improving and we think it reasonable for the purposes of planning to assume the possibility of gradually achieving by 1970 a peak rate of 80 movements in one hour, consisting of 40 arrivals and 40 departures, with a sustained rate of 64 movements for short periods of more than one hour. The achievement of such a movement rate will tax air traffic control to the limit and will depend on future aircraft having approach performances that are no more exacting than existing types, as well as on continued and rapid development in the equipment and technique of control.

16. With a peak of 80 and a sustained rate of 64 movements an hour of aircraft of the size expected in 1970, the airport will have to be equipped to handle some 4,700 passengers an hour in the busy periods at summer week-ends, with a very occasional peak of 5,900 passengers, i.e. the busy hour equivalent of 12½ million passengers in the year. These figures, representing twice the aircraft movement rate and four times the passenger movement rate in busy hours in 1956, are a measure of the scale on which we must plan, and of the formidable task which the airport will have to meet.

17. Even the most optimistic view of air traffic control and aircraft developments would not lead us to expect that it will be possible to achieve the movement rates necessary to handle all the estimated traffic offering, namely, 77 in the peak hour in 1965 and 85-106 in the peak hour in 1970 (see paragraph 13). Traffic is likely to increase over this period more rapidly than air traffic control capacity\* and the excess must be accommodated elsewhere. We have already allowed for the transfer to Gatwick of the Channel Islands services from the summer of 1958 onwards, but whether Gatwick will be able to take much more traffic in the first stage of its development is uncertain. We recommend that early consideration should be given to the completion of Stage 2 of the Gatwick plan and also to the possibility that yet a further airport will need to be developed by 1970 to meet the full requirement.

## MAIN PLANNING REQUIREMENTS

18. The requirements we are asked to consider fall broadly into three parts concerning
- (i) maintenance area requirements,
  - (ii) terminal facilities, and
  - (iii) the internal road system.

Part (iii) concerns the whole airport but we consider that road problems, other than those within the central terminal area, can be settled by administrative action. Accordingly we deal with this part of the requirements only in the context of terminal facilities (paragraphs 50 and 60).

### MAINTENANCE AREAS

19. The three maintenance areas are shown in the diagram at Appendix 3—No. 1 on the eastern, No. 2 on the south-eastern and No. 3 on the south-western boundary of the airport. British Overseas Airways Corporation and British European Airways have already leased most of the land in No. 1 area and established their main bases there. Pan-American World Airways and Hunting-Clan Ltd. occupy a substantial part of No. 2 area. In both areas plans for large-scale extensions and hangar construction to meet long-term requirements are already so far advanced that we need do no more than note the considerable development which is in train.

\* The estimates of the busy hour traffic demands as compared with the achievable air traffic control capacity are as follows:

	1960	1965	1970	
			(a)	(b)
<i>Aircraft movements per hour</i>				
Estimated demand—aircraft standard busy hour rate	39	63	85	68
Estimated capacity—sustained rate	40	52	64	64
(a) assuming average aircraft capacity of 80 seats.				
(b) assuming average aircraft capacity of 100 seats.				

(The standard busy hour rate is the hourly rate of movement which is equalled or exceeded during 30 hours in the three peak summer months.)

It is possible, however, that before very long airlines will have insufficient space in No. 1 and No. 2 maintenance areas to provide all the hangarage required, and development in No. 3 maintenance area may be necessary.

20. The Ministry are negotiating the purchase from the Middlesex County Council of a small area of land outside the boundary of No. 1 maintenance area to provide earth banks for noise abatement and for a perimeter road to take the place of internal roads over which B.O.A.C. propose to build new hangars and hardstandings. We recommend that these negotiations should be pressed forward with all speed.

#### TERMINAL FACILITIES

21. At the moment there are two terminal areas:

- (1) London Airport North, the terminal for the long-haul operators;
- (2) London Airport Central, the terminal for the short-haul operators who moved from Northolt to London Airport in 1954 and to the central area in 1955 when the first stage of development was completed.

In London Airport North passengers are handled in temporary buildings adjacent to the Bath Road and the aprons lie between these buildings and No. 1 runway. The aprons are already congested and there is no room for expansion. Modern buildings for the long-haul operators with adequate apron stands for aircraft are urgently required.

The central terminal area (London Airport Central) had been conceived as the terminal for all operators using London Airport and plans worked out following the Advisory Layout Panel Report envisaged first a terminal building on the south-east face for short-haul services, secondly a terminal building for long-haul services, thirdly a freight building and fourthly a possible third passenger building if the first two passenger buildings proved insufficient.

22. The question which brings us to the heart of our problem is whether future development should proceed on the lines of the original plan. Is the central area, as designed, large enough to accommodate all the services intended for it? If not, should we look for a subsidiary terminal for passengers and freight elsewhere on the airport, or can we more conveniently extend the boundaries of the central area even though this means eliminating one or more of the existing runways?

#### CAPACITY OF THE CENTRAL TERMINAL AREA

23. The central area is roughly a hexagon contained within the runways. At the outer edge of the hexagon are the aircraft hardstandings, linking taxiways, safety clearance zones and apron service roads. This outer zone surrounds the "landside" terminal, which is connected with the Bath Road by a tunnel, and which contains the terminal buildings, roads, vehicle parks, public enclosure, fuel installations and other services. In the centre is the Control Tower and Administrative Block, on the south-east face the short-haul passenger building and at the eastern apex Queen's Building devoted to technical services and facilities for spectators.

24. There are still sites within the central area for the construction of two more passenger buildings, and although the existing short-haul passenger building was designed to handle up to 2,000 passengers in a busy hour, the peak movement so far has not exceeded 1,101 passengers an hour. Similarly there is room for vehicle parks sufficient to meet demands for the next two or three years, and the fourth (north-west) apron has not been built. The total area so far not brought into use, excluding about  $5\frac{1}{2}$  acres occupied by temporary freight sheds and some  $14\frac{1}{2}$  acres for temporary car parks, amounts to approximately 21 acres.

25. There is thus a margin for expansion within the central area, but it can no longer be considered adequate in view of the prospect of aircraft movements mounting in the next few years at the rate of 7 per cent\* per year and passenger traffic at the rate of 15 per cent per year. What is more, there is already congestion at the north terminal and alternative accommodation must be found before long in the central area for the long-haul operators using that terminal. Indeed, for aprons alone we need half as many stands again as can be provided on the existing outer zone of the central area. On the assumption that all passenger handling and associated freight operations are concentrated in the centre together with ancillary services and adequate car parks for passengers and public, a detailed study shows that we could comfortably use a terminal area of 264 acres as compared with the 140 acres available under the original plan.

\* Excluding Channel Islands traffic which will be operated from Gatwick.



26. While recognising that this provisional estimate represents the ideal and that the area required would be capable of reduction given stringent measures to reduce time spent by aircraft on aprons and cars in parks, we have concluded that more terminal space is needed outside or within the central area if the traffic is to be handled without loss of efficiency and serious inconvenience to users of the airport.

## POSSIBILITIES OF RELIEVING THE CENTRAL AREA

### A SECONDARY PASSENGER TERMINAL

27. We have considered whether means can be found of relieving the central area of some of the functions originally intended for it.

Any proposal involving a secondary passenger terminal separate from the main terminal is open to the general objection that it would lead to greater dispersal of administrative and engineering services than if all operations were concentrated in the centre as the Advisory Layout Panel visualised. The international short-haul passenger services, accounting as they do for two-thirds of the traffic, must stay in the main terminal. It is also impracticable to keep the long-haul operators in their present accommodation on the north terminal, both because the aprons are already congested and also because these important services should be handled in modern buildings comparable with those already provided for the short-haul operations. Only two possibilities deserve serious consideration: first, the transfer to the north terminal of the internal United Kingdom services of British European Airways, which are at present handled in two channels of the south-east face passenger building and require up to ten apron stands; and secondly, the development of a new terminal for the long-haul operators in No. 3 maintenance area south-west of the airport and south of No. 5 runway (see Appendix 3).

28. The first of these proposals, namely, the use of the north terminal for domestic services, is open to the objection that aircraft using this terminal would frequently need to cross No. 1 runway, one of the most-used runways of the airport, and in the traffic conditions forecast for 1965 and 1970 such aircraft would either suffer serious delay or cause substantial interference in busy hours with air traffic using this runway. Some aircraft are used on both internal and international routes, and the division of the short-haul services between two terminals would require increased and extensive ground movement of aircraft between these terminals. Since the domestic traffic is only a small fraction of the total, the relief afforded to the central area by this means would hardly affect the need for expansion in the centre and would not be sufficient to justify the consequent interference with air traffic.

The second proposal, namely, the use of No. 3 maintenance area for long-haul services, is scarcely more attractive than the first. There would be no quick and direct route between the area and the central terminal unless a road tunnel were constructed—a point of especial concern to the passengers in transit changing at London Airport from long-haul to short-haul routes and vice versa. Land would be occupied by the terminal which may well be needed later on for development for maintenance purposes, and finally aircraft crossing No. 5 runway might ultimately create a problem for air traffic control.

### HANDLING OF FREIGHT OUTSIDE THE CENTRAL AREA

29. About 75 per cent of the freight carried by air moves in passenger aircraft, and much of it occupies the space left unfilled by passengers and their baggage. Export freight accounts for 39 per cent of the total and facilities for bording and loading it on the passenger aircraft must be near the passenger aircraft aprons, as the available space is often not known until shortly before the departure of the aircraft and last-minute allocations are necessary. Thus passenger and freight operations must for the most part be very closely integrated, and if terminal facilities for the one are remote from the other flexibility of allocation is lost, payload of aircraft suffers and delay to cargo may result. There must therefore be provision in the centre for the essential freight handling facilities.

## PROPOSALS FOR EXPANDING THE CENTRAL AREA

30. As may be seen from Appendix 3, the central area is bounded on the East and West by two parallel sets of runways, Nos. 2 and 7 in the N.E./S.W. directions and Nos. 4 and 6 in the S.E./N.W. directions. Expansion implies using one or more of these runways for other purposes.\*

\* In considering the expansion of the centre the possibility of withdrawing runways Nos. 1 and 5 can be ignored. These runways are the longest, most used and best suited for extension if required, and withdrawal of either is quite out of the question.

We can contemplate such a possibility today because the introduction of aircraft with steerable nose wheels and better handling characteristics has permitted safe landing and take-off with higher cross-winds than was practicable with tail-wheel types. The maximum permissible steady cross-wind component may now safely be put at 18 knots, whereas the maximum which could be used for planning purposes by the Advisory Layout Panel was 12 miles an hour, roughly 10 knots. It is against this new background that we have considered the question whether all existing runways are still essential and, if not, which can be converted to other uses.

31. No. 4 runway is the shortest, cannot be extended without major road diversions, and with the modern types of aircraft now in operation lies in a direction rarely needed having regard to wind conditions. So far no runway or approach lighting has been installed on it because, on the occasions it has been found necessary to use the south-east or north-west directions at night, use of No. 6 runway has normally sufficed for the reduced rate of traffic during the night hours.

32. Meteorological data show that with runways in the E./W. and N.E./S.W. directions and assuming that steady cross-wind components of up to 18 knots are acceptable, the N.W./S.E. direction would have to be used on only 0.14 per cent of occasions during a year. This amounts to an average of 12 hours a year, with a maximum of 5 hours in any one quarter and none in the summer. On this basis the usability of the airport would be 99.86 per cent without runways in the N.W./S.E. direction which may be compared with the minimum of 95 per cent recommended by the International Civil Aviation Organisation. This figure and the limitations of the runway noted above have led us to conclude that the withdrawal of No. 4 would have an insignificant effect on future flying operations at the airport.

33. We have examined the possibility of withdrawing No. 2 runway in addition to No. 4 since this would allow aircraft to pass freely between the central area and No. 1 maintenance area to the east. We concluded, however, that No. 2 could not be spared because it is the third most-used runway on the airport and lies in the direction of the strong south-westerly winds.

34. Expansion of the central area towards the west has attractions because no buildings have so far been constructed on the western faces of the diamond. Such expansion would affect runways Nos. 6 and 7. The withdrawal of No. 7 runway is open to objection because a set of parallel runways is essential in the N.E./S.W. directions to attain maximum capacity. No. 6 runway is parallel to No. 4 and its withdrawal would mean that both N.W./S.E. runways would be put out of action. While this is the set of parallel runways that would be missed the least, we consider that No. 6 should be kept in service as long as possible, particularly during the working life of the older types of aircraft such as the DC-3's which cannot operate safely in an 18-knot cross-wind component. It should, however, be possible to spare it later for other purposes if the need for more space so requires.

35. We thus conclude that expansion over one or more runways is practicable and a better way of meeting the need than any of the possibilities covered in paragraphs 27-29. We accordingly recommend that

- (a) Runway No. 4 should be withdrawn to provide for expansion in a north-easterly direction. By this means an additional 52 acres would be available for the central terminal. The runway surface would continue to be used as a main taxiway and later part of the northern half could be used for aircraft stands.
- (b) For the time being runway No. 6 should be kept in service as both runway and main taxiway, but part should be used for aircraft stands later on if this becomes essential. By withdrawing runway No. 6 another 40 acres would be secured for the central terminal area, making an additional 92 acres in all.

## NEW FACTORS AFFECTING THE LAYOUT OF THE ENLARGED CENTRAL AREA

### COVERED WAYS TO ENABLE PASSENGERS TO MOVE ON FOOT BETWEEN BUILDINGS AND AIRCRAFT—THE PIER SYSTEM

36. The layout of the enlarged area depends to a great extent on the method to be used for moving passengers between the buildings and those aircraft not immediately adjacent to them.

37. The existing aprons in the central area have been planned to provide for inner and outer rows of aircraft stands separated by an inner taxiway and arranged around the landside terminal. The inner stands on the south-east aprons lie against the face of the short-haul

building and Queen's Building and may be reached by passengers on foot by way of short covered ramps; but to reach the outer stands passengers must use buses passing through tunnels under the aprons.

38. The present system has the merit of providing the greatest flexibility in aircraft operation and it is well suited to the existing arrangements under which passengers, on arrival at the terminal, are assembled in complete aircraft loads and escorted through the controls and to the aircraft by members of the airline staff. It would not be well adapted however to the handling of passengers travelling by the larger aircraft which are expected to come into use in increasing numbers during the period up to 1970. Several buses would be required to carry passengers to and from the outer stands where most of these aircraft would have to be located. Moreover, many passengers dislike having to board or alight from buses at the beginning or end of their flight.

39. If passengers were able to move on foot to and from the aircraft and through Customs and other controls individually and unescorted as in other forms of transport a substantial economy of airline staff and the speeding up of ground handling would be achieved. In addition, whether or not this "trickle" load system is adopted the operating expenses of the airport would be significantly reduced if the airport buses could be largely dispensed with. We were therefore impressed by the desirability of planning the enlarged aprons and the new buildings in such a way that passengers could move on foot between the terminal buildings and the aircraft.

40. A way of achieving this which is widely used in the United States and elsewhere is the pier, otherwise known as the "finger and gate". The piers are covered ways extending from the passenger building and giving access by gates to the aircraft stands which are arranged alongside. Where piers are of two storeys the covered way is on the first floor connected by staircases to the gates and adjacent passenger waiting areas. This allows the covered way to be carried over apron roads and provides room on the ground floor for apron services which would otherwise have to be accommodated in separate buildings on the edges of the apron. Considered as a connection between the building and the aircraft therefore the pier is no more than a logical extension of the present airside gallery and covered ramps on the south-east face passenger building and Queen's Building.

41. Piers are planned for Gatwick Airport and for many principal Continental airports. They have been adopted by Manchester Corporation as part of their plan for a new terminal building at Ringway and are being considered by the Ministry for inclusion in a new terminal at Prestwick.

42. The introduction of piers at London Airport would lead to radical changes in the present apron layout, but we believe that their use would result in substantial economies in manpower and operating costs, a conclusion which was also reached by a firm of consultants employed by the Ministry to investigate the apron services at London Airport. We recommend therefore that a pier system should be adopted and the layout we propose is based on this principle.

#### GROUND HANDLING OF LARGE JET AIRCRAFT

43. Some of the largest jet aircraft yet designed, several hundreds of which have been ordered by the world's airlines, including B.O.A.C., are planned to start operating into London Airport in 1958. Studies of the characteristics of modern jet aircraft have given an indication of the problems to be expected, but as yet there is insufficient knowledge to make it possible to relate apron layout and ground organisation specifically to the needs of these aircraft.

44. Although the handling of jet aircraft is not strange to the Ministry or to B.O.A.C., these new aircraft are far heavier, larger and more powerful than the Comet series previously operated by B.O.A.C. or the Russian Tu. 104 which has visited London Airport on a number of occasions.

45. Some of the problems which have confronted us and which we have taken into account as far as possible in the light of information at present available are:

- (a) In comparison with propeller-driven types, considerably greater noise and blast will arise when these aircraft are manoeuvred under power on the ground. Special measures such as towing may be needed if, because of their noise and blast, they cannot acceptably be moved under their own power in areas where other apron activities are in progress. With a weight of up to 300,000 lb. when loaded, such aircraft will be nearly double the weight of any existing civil aircraft and ground handling by tractor may be difficult. This will slow down movement on the apron.

- (b) Up to 150 passengers may be carried and provision will have to be made for these larger loads both in the buildings and between the buildings and the aircraft.
- (c) A maximum uplift of 21,000 gallons of fuel is far in excess of any existing requirements and special arrangements for fuelling these aircraft will be needed.

46. These problems, so far unresolved for lack of positive information, indicate the need to allow as much flexibility as possible (see paragraph 54 below) in the layout of the aprons, particularly those which will be used by the long-haul operators for these aircraft.

#### NEED FOR FURTHER STUDY OF THE HANDLING OF LARGE JET AIRCRAFT

47. Jet aircraft problems, including those affecting the layout of aprons and ground handling arrangements, are being studied by the International Civil Aviation Organisation, the International Air Transport Association and by individual States. Nevertheless, the lack of specific information clearly shows that much urgent work needs to be done by aircraft manufacturers and operators to clarify and to solve such problems which vitally affect aerodrome design and the effective use of the aircraft themselves.

#### RAILWAY CONNECTION BETWEEN LONDON AND LONDON AIRPORT

48. The British Transport Commission has been investigating the practicability of a rail link from the centre of London to the airport. Should a rail link be decided on, its construction should be planned in phase with the airport development if waste, delay and unnecessary disturbance to the operations of the airport are to be avoided. Assuming that the railway line and station within the airport are largely underground they will not affect the surface layout of the airport terminal buildings, but the location of exits and entrances to the underground station may affect the road pattern which therefore cannot be settled until a decision on the rail link has been taken.

#### OPERATION OF HELICOPTERS FROM LONDON AIRPORT

49. Although the nature and volume of future helicopter traffic is uncertain, provision should be made for possible operations later. Final arrangements will depend among other things on air traffic control requirements and the ground and air limitations imposed by navigational aids. It seems probable that in visual weather conditions helicopters might be able to use the normal aprons, as indeed is planned at New York. A permanent site for use in either visual or instrument weather conditions can be provided in the North Terminal and this should be reserved in case helicopter operations in the central area should prove impracticable.

### SUMMARY OF REQUIREMENTS FOR THE LAYOUT OF THE ENLARGED CENTRAL AREA

50. We set out to meet the following main requirements:
- (a) Terminal passenger building space to handle up to 4,700 passengers in a busy hour or roughly 2,700 more passengers than can be handled in the existing short-haul building on the south-east face.
  - (b) An area of up to 300,000 sq. ft. to be allocated to freight\*.
  - (c) Aprons sufficient for an ultimate peak requirement of up to 105 aircraft stands†.
  - (d) Buildings and stands to be arranged so that as many stands as possible should be within walking distance of the buildings and connected to them by piers (see paragraphs 36-42 above).
  - (e) Sufficient flexibility of layout to permit changes as operating experience of large jet aircraft is gained.
  - (f) A satisfactory functional and architectural relationship to be preserved between the new buildings and the existing Queen's Building and South-East Face Building.

\* A study has shown that freight requires approximately 1 sq. ft. of ground space per ton per year, which might be reduced by improved handling methods, and that freight traffic of some 300,000 tons per year at least is to be expected by 1970.

† It was estimated that the ultimate requirement for stands might be of the following order:

Short-haul gate positions...	...	...	...	...	...	...	...	...	52
Short-haul minor maintenance and parking stands	...	...	...	...	...	...	...	...	16
Long-haul and miscellaneous gate positions	...	...	...	...	...	...	...	...	31
Freight stands	...	...	...	...	...	...	...	...	6
TOTAL									105

- (g) Adequate vehicle parks and a road system to provide for the circulation of traffic passing through the tunnel at the rate of 2,500 vehicles in each direction in peak hours; freight traffic to be separated as far as possible from passenger traffic.
- (h) The possibility of an underground railway station in the central terminal area to be safeguarded.
- (i) Existing facilities to be kept in use as far as possible so as to avoid nugatory expenditure.

51. In addition we had to preserve a smooth taxiway flow round the central area and between runways and aprons; to observe the necessary operational and telecommunications clearances; and to take account of the requirements for fuelling aircraft.

## THE RECOMMENDED LAYOUT

52. We have considered some twelve different schemes designed to satisfy in varying degrees these complex and sometimes conflicting requirements and we have come to the unanimous conclusion that the layout depicted on the centre photograph facing this page is the best. This layout increases substantially the areas available both for stands on the airside and for vehicles and buildings on the landside.

The main features of this layout are as follows:

### SECOND SHORT-HAUL PASSENGER BUILDING ON THE NORTH-EAST FACE

53. By placing the building as close as possible to the existing South-East Face and Queen's Buildings we provide for an integrated group of short-haul and administrative buildings with associated aprons in an arrangement which permits the public to move with ease from one to the other. The building is sited forward of the existing building line to provide enough space nearby for vehicles and for roads.

### LONG-HAUL PASSENGER BUILDING ON THE SOUTH-WEST FACE

54. This has been sited on what is now the south-west apron in order to provide more space within the landside terminal and to bring the greatest number of stands ultimately within reach of the building if No. 6 runway is later absorbed in the apron system. The plan places the long-haul building somewhat in isolation from the other buildings in the central area and may cause some duplication of administrative services\*. Nevertheless we think it the best location. Sooner or later a building in this area will be required and the long-haul operations are better suited to separation from the rest than any other single group. Sufficient stands can conveniently be found here for the long-haul aircraft and the layout of the aprons is adaptable to the needs of the larger jets without interference with the short-haul aprons on the eastern faces. In this position the operations of these new aircraft will be more remote from neighbouring residential areas than on any other apron in the central terminal. The piers extending towards No. 6 runway are not intended for early construction and there will be room for certain changes to this part of the layout in the light of practical experience with the new jet aircraft.

### FREIGHT BUILDING

55. By locating a freight building parallel to No. 1 runway beyond the existing building line, we have secured further space in the centre and separation of freight and passenger traffic on the roads. There is room for freight accommodation up to 300,000 sq. ft. floor area. Should more space ultimately be needed it may be necessary to deal with import freight outside the central area.

### AIRCRAFT STANDS

56. A total of up to 93 stands is provided which may be increased to 101† if No. 6 runway is withdrawn.

\* Up to 11,750 sq. ft. of office and other accommodation hitherto reserved for the long-haul operators in Queen's Building will be available for testing for other purposes if such accommodation must be provided for convenience in the long-haul building itself.

† This figure is made up as follows:

Short-haul gate positions	...	...	...	...	...	...	50
Short-haul minor maintenance and parking stands	...	...	...	...	...	...	16
Long-haul and miscellaneous gate positions	...	...	...	...	...	...	23 (31)
Freight stands	...	...	...	...	...	...	4
TOTAL							93 (106)

The figures in brackets show the number of stands planned if No. 6 runway is withdrawn later.

#### CONNECTIONS BETWEEN BUILDINGS AND AIRCRAFT

57. Each passenger building is connected to as many aircraft stands as possible by means of piers.

#### VEHICLE PARKS

58. Within the building line we now have some 76 acres as compared with the existing 47 acres, and this, after allowing for roads, fuel installations, etc., will provide for about 20 acres of vehicle parks. We consider that this will be adequate provided that measures are taken to limit the time spent by cars in the central area. Nearly 50 per cent of the vehicle parking spaces are occupied by cars which remain there for over 24 hours, and many of these cars could equally well be parked in the less congested areas near the Bath Road. We recommend that schemes for encouraging motorists to leave their cars outside the central area by means of differential parking charges, etc., or a system of collection and delivery by car park attendants should be given close consideration.

#### ROAD ACCESS TO THE CENTRAL AREA

59. We have made no provision for an additional road tunnel because the existing tunnel should be adequate until 1970. This is on the assumption that fuelling vehicles, which at present cause delays, will not use the tunnel and that the roads leading to the airport, together with the tunnel approaches, have sufficient capacity to permit a free flow of traffic through the tunnel. Unless a free flow through the tunnel can be maintained, the capacity of the airport will suffer. We are informed, however, that the Bath Road will be very congested by the early 1960's. We recommend, therefore, that urgent steps should be taken to improve the main road approaches to the airport.

#### INTERNAL ROADS

60. The road system within the central area cannot be planned with precision until the detailed planning of the buildings has been completed. We are satisfied, however, that the proposed layout allows for an effective road traffic circulation, and an outline of what can be done is shown in the photograph.

### PHASING OF CONSTRUCTION

61. While we recommend that the scheme should be approved as a whole, it will clearly be out of the question, if only by reason of restricted space, to undertake simultaneously all the new construction proposed. We have therefore given some thought to the preparation of a programme which will spread the cost and enable the airport to continue to function as smoothly as possible during construction and to meet the changing traffic requirements.

62. The first and pressing need is to bring the long-haul operators from the north terminal into the central area, for the aprons on the north terminal are already congested and the situation will worsen as the larger aircraft such as the Britannia come increasingly into service. We have already concluded that the permanent home of the long haulers should be on the south-west and we therefore recommend that the preparation of designs for this long-haul passenger building should be put in hand without delay; if this is done it should be possible to construct the building by the early part of 1961.

63. Those parts of the road system which will be required at the outset should be urgently put in hand. Furthermore, since the construction of the long-haul building will put out of use hard-standings now available for aircraft, immediate action should be taken to extend the area of concrete in order to provide additional aircraft stands which in any event will ultimately be required. This will entail construction both to the south-west and to the north-east of the central area, and we envisage that by 1961 about half the total programme of apron construction should be completed. A detailed programme should be worked out with the object of going out to contract as soon as possible.

64. The short-haul operators will remain in the South-East Face Building. A second building on the north-east for short-haul operators to accommodate roughly the same amount of traffic as the existing South-East Face Building will be required before long, but we cannot at this time forecast whether it would be more convenient and economical to build it to its full size at one time with the danger of under-utilisation of the existing building, or to put it up in stages subject to the serious and possibly unacceptable penalty of forcing operators to split their services between the two buildings. We consider, however, that a decision on this question need not be

taken immediately, but should be reviewed within twelve months and in the light of the experience in the South-East Face Passenger Building in the coming summer. The necessary stands for the rapidly growing short-haul traffic are included in the programme for the first four years; further areas will be constructed as required.

## COST

65. It is not possible to offer more than a very broad estimate of cost at this stage since it is only when buildings, etc., have been designed in some detail that close estimating can be done. The best estimate we can make on the basis of present-day prices is that the whole development cost will be something of the order of £17 million. According to the phasing outlined in paragraphs 61-64 this will entail expenditure of roughly £6 million in the financial years 1958-59 to 1960-61, and a further £2 million a year in successive years. So far £26 million have been spent from civil votes on development of the airport and there are commitments in hand as well as proposals in the pipeline totalling £3½ million. The expenditure now recommended would thus bring the total capital cost up to £47 million approximately at present prices.

66. We have throughout borne in mind that we are required to produce the most economical layout. A complete study of the economics of the developed area is hardly within our competence, for it would inevitably lead us into the field of airport charges and revenue. Nor have we thought it our duty to give preference to a scheme of development merely because it involves the least capital expenditure. Indeed, we rejected schemes which, though less costly in terms of capital expenditure than the one we recommend, fall short in terms of service and economy of operation. Our main concern has been to provide for the full and balanced development of the land and existing facilities at our disposal, so that the airport may render the most efficient and economical service for aircraft, passengers, freight and the public. This is what we believe we have achieved in the layout recommended in paragraphs 52-60.

67. All who are closely concerned with civil aviation in this country and elsewhere are convinced that a very great expansion of air traffic lies ahead. In this confidence British Overseas Airways Corporation and British European Airways alone have a programme of investment estimated at over £120 million for aircraft due for delivery up to 1961. A corresponding figure for world investment in new aircraft is put at £1,000 million. At the same time the responsible authorities throughout the world are busy with plans for the modernisation and development of their airports on a correspondingly large scale to serve the aircraft of the future and the growing volume of passengers and cargo.

68. In our opinion the expenditure on the airport of a sum of the order of £17 million is required to provide a full return on the capital investment. It is further necessary if London Airport is to continue to render the standard of service appropriate to its geographical position on the air routes of the world and to the needs of civil aviation and the commerce of this country.

## SUMMARY OF RECOMMENDATIONS

### CAPACITY OF THE AIRPORT

69. (1) The airport should be developed to enable it to handle by 1970 up to 80 aircraft movements in the peak hour and 64 movements an hour for short periods of more than one hour—the maximum rate which air traffic control can be expected to handle with safety by that time. In terms of passengers the airport should be equipped to handle 4,700 passengers per hour at busy periods with an occasional peak of 5,900 passengers per hour, corresponding to a total traffic of 211,000 air transport movements and 12½ million passengers in the year, as compared with 109,000 movements and 3 million passengers in 1956.

(2) Traffic is expected to increase more rapidly than air traffic control capacity and London Airport is unlikely to be able to take all the traffic offering. Urgent consideration should be given to the second stage of development at Gatwick Airport and to the possibility that a third airport may need to be developed.

### MAINTENANCE AREAS

(3) Negotiations for the purchase of some additional land from the Middlesex County Council, for the purpose of constructing earth banks for noise abatement and a perimeter road to provide fast access between the maintenance areas and other parts of the airport, should be pursued with all speed.

#### TERMINAL AREAS

(4) Terminal facilities for all services, including freight, should be provided in the central terminal area. To make this possible the area as originally designed must be considerably enlarged to provide additional hardstandings on the airside and a larger area for roads and car parks on the landside of the terminal area.

(5) Expansion of the central area should be achieved by withdrawing No. 4 runway from use to provide 52 additional acres. If more aircraft stands are eventually needed, No. 6 runway should be withdrawn to provide another 40 acres. In this way a total of 92 acres can be provided for buildings and aircraft stands additional to the 140 acres contained within the central area as planned.

(6) A long-haul passenger building should be constructed as soon as possible to take the services now operating in the congested north terminal, and a second passenger building should be built when required to provide for the growing short-haul traffic.

(7) A freight building should be provided with space for an eventual floor area of up to 300,000 sq. ft.

(8) The layout described in paragraphs 52-60 of the report should be adopted, providing for a long-haul terminal on the south-west apron, a second short-haul building on the north-east of the central area and a freight building on the northern side of the central area and parallel to No. 1 runway.

#### PIERS

(9) Piers projecting from the passenger buildings onto the aprons should be built to enable passengers to go on foot between buildings and aircraft stands. In this way the use of buses between building and aircraft will be largely eliminated, passenger flow improved, and airline and airport operations costs reduced.

(10) The layout of the aprons and piers for the long-haul building should be as flexible as possible to provide for large jet aircraft, as little is now known about the problem of handling such aircraft on the ground.

#### PHASING OF CONSTRUCTION

(11) Since the immediate need is to bring the long-haul operators from the north terminal into the central area, the preparations of designs for the building on the south-west apron for their use should be taken in hand without delay. Before this building can be put up an improved internal road system and additional concrete on the north-east and south-west must be provided to match the growth of traffic and to accommodate aircraft now using the hardstandings which will form the site of the new building. A detailed programme should be worked out with the object of completing the long-haul building and about half the total programme of apron construction by early 1961.

(12) A decision on whether the new building for short-haul operators should be built to its full size at one time or in stages need not be taken at once. The question should be reviewed within twelve months in the light of the experience of the south-east building during the summer of 1957.

#### STUDY OF JET AIRCRAFT PROBLEMS

(13) Further study of the problems connected with the ground handling of large jet aircraft is required and should be taken in hand by aircraft manufacturers and operators as a matter of urgency.

#### OPERATION OF HELICOPTERS

(14) Until experience has been gained in the operation of helicopters into the central area, a site should be reserved at the north terminal.

#### CAR PARKING OUTSIDE THE CENTRAL AREA

(15) Schemes for encouraging motorists to leave their cars outside the central area should be given close consideration.

#### RAIL LINK WITH AIRPORT

(16) A decision on the advisability of linking the airport with the centre of London by rail should be taken before the detailed planning of the road system within the central area is completed, since the location of exits and entrances to an underground station may affect its pattern.



(17) Improvements to the main road approaches to the airport should be given urgent consideration.

## ACKNOWLEDGEMENTS

70. In conclusion we wish to express our thanks to the members of the staffs of the airline corporations and the Ministry of Transport and Civil Aviation, including their Economics Division and Aviation Operational Research Branch, who contributed to the many studies on which our conclusions are founded; and to our Secretaries—Mr. Pugh, whose help in the early stages before his transfer on promotion to other work was invaluable; Mr. Collins, on whose knowledge and experience we greatly relied; and finally Mr. Vivian and Mr. Heathcote, who admirably filled the breach caused by Mr. Collins's illness at the end of 1956, and who played a tireless and constructive part in the preparation of our report.

(Signed) P. ERIC MILLBOURN

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*April, 1957*

# London Airport Forecasts of Traffic and Capacity up to 1970

## ASSUMPTIONS

1. (a) There will be no major political or economic disturbances.
- (b) There will be a continued increase of real income per head.
- (c) There will be no restraints on the development of air transport caused by insufficient development of complementary industries.
- (d) The level of air fares relative to those of surface transport will continue to fall.
- (e) The rate of increase of passenger traffic will decline progressively during the period, from 15 per cent per annum 1956-60 to 12 per cent per annum in 1961-65 and to 9 per cent per annum in 1966-70.
- (f) The average passenger load factor on short hauls will be 65 per cent up to 1960 and 62½ per cent from 1961-70 and on long hauls 62½ per cent throughout.
- (g) The average seating capacity of aircraft using London Airport will be 58 in 1960, 70 in 1965 and between 80 and 100 in 1970.
- (h) The present relation between peak traffic and annual traffic will remain constant.
- (i) Air traffic control will be able to handle aircraft movements at sustained rates for short periods of more than one hour of 40 in 1960, 52 in 1965 and 64 in 1970.

We also took into account the transfer of all Channel Islands services to Gatwick Airport from 1958.

## ESTIMATED TRAFFIC OFFERING

### 2. ANNUAL TOTALS

	<i>Actual*</i>		<i>Estimates</i>		
	1956	1960	1965	1970	
				(a)	(b)
Terminal passengers (000) ...	2,818	4,800	8,800	13,600	13,600
Air transport aircraft movements (000) ...	101	130	210	280	225

\* Excluding Channel Isles traffic

### 3. HOURLY VOLUME IN PEAK AND NEAR-PEAK CONDITIONS

	1960	1965	1970	
			(a)	(b)
<i>Absolute peak hour</i>				
Passengers ...	2,300	4,100	6,300	6,300
Aircraft ...	50	77	106	85
<i>Standard Busy Hour Rate (c)</i>				
Passengers ...	1,800	3,200	4,900	4,900
Aircraft ...	39	63	85	68

## ESTIMATED TRAFFIC CAPACITY

### 4. ANNUAL TOTALS

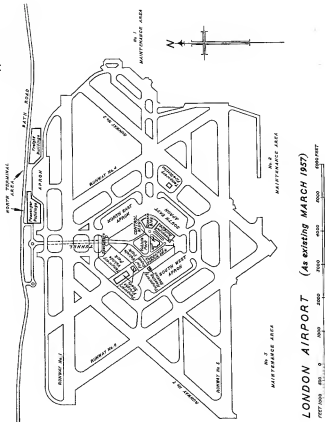
	1960	1965	1970	
			(a)	(b)
Terminal passengers (000) ...	4,900	7,300	10,300	12,800
Air transport aircraft movements (000) ...	132	174	211	211

### 5. HOURLY VOLUME IN PEAK AND NEAR-PEAK CONDITIONS

	1960	1965	1970	
			(a)	(b)
<i>Absolute peak hour</i>				
Passengers ...	2,300	3,400	4,700	5,900
Aircraft ...	50	65	80	80
<i>Standard Busy Hour Rate (c)</i>				
Passengers ...	1,850	2,700	3,800	4,700
Aircraft (sustained rate) ...	40	52	64	64

## NOTES

- (a) Assuming an average aircraft size of 80 seats.  
 (b) Assuming an average aircraft size of 100 seats.  
 (c) *Standard Busy Rate*. This is the hourly rate of movement which is equalled or exceeded during 30 hours in the three peak summer months. Similar methods of establishing a high rate below the absolute and therefore relatively occasional peak but above the average are used by other airport authorities on the continent and in the United States.



LONDON AIRPORT (As existing MARCH 1957)



1. Existing layout of the Central Terminal Area



2. Proposed layout of the Central Terminal Area



3. Proposed layout of the Central Area superimposed on the existing layout

#### KEY

- |  |   |
|--|---|
| 1. Control and Administrative Building | 7. Fuel Installation  |
| 2. Queen's Building                    | 8. Existing No. 4 Runway. Area to be developed as Aircraft Park and for minor maintenance—up to 15 aircraft |
| 3. South-East Face Passenger Building  | 9. Tunnel Entrance  |
| 4. Proposed North-East Face Building   | P. Vehicle Parks  |
| 5. Proposed South-West Face Building   |   |
| 6. Proposed Freight Building           |   |

